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Obesity and Mental Disorders During Pregnancy and Postpartum: A Systematic Review and Meta-analysis

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Abstract

Objective—To evaluate the prevalence and risk of antenatal and postpartum mental disorders among obese and overweight women.

Data sources—Seven databases (including MEDLINE and ClinicalTrials.gov) were searched from inception to January 7, 2013, in addition to citation tracking, hand-searches and expert recommendations.

Methods of study selection—Studies were eligible if antenatal or postpartum mental disorders were assessed with diagnostic or screening tools among women who were obese or overweight at the start of pregnancy. Of the 4,687 screened articles, 62 met the inclusion criteria for the review. The selected studies included a total of 540,373 women.

Tabulation, integration, and results—Unadjusted odds ratios were pooled using random-effects meta-analysis for antenatal depression (n=29), postpartum depression (n=16) and antenatal anxiety (n=10). Obese and overweight women had significantly higher odds of elevated depression symptoms than normal-weight women and higher median prevalence estimates. This was found both during pregnancy (obese OR 1.43, 95%CI 1.27-1.61, overweight OR 1.19, 95%CI 1.09-1.31; median prevalence: obese 33.0%, overweight 28.6%, normal-weight 22.6%) and postpartum (obese OR 1.30, 95%CI 1.20-1.42, overweight OR 1.09, 95%CI 1.05-1.13; median prevalence: obese 13.0%, overweight 11.8%, normal-weight 9.9%). Obese women also had higher odds of antenatal anxiety (OR 1.41, 95%CI 1.10-1.80). The few studies identified for postpartum anxiety (n=3), eating disorders (n=2) or serious mental illness (n=2) also suggested increased risk among obese women.

Conclusion—Healthcare providers should be aware that women who are obese when they become pregnant are more likely to experience elevated antenatal and postpartum depression symptoms than normal-weight women, with intermediate risks for overweight women.

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Introduction

The proportion of women who are overweight (body mass index(BMI) 25-30 kg/m²) or obese (BMI>30 kg/m²) when they become pregnant is substantial and rapidly increasing; a recent study estimated that over 20% of US women are obese at the start of pregnancy.(1) High pre-pregnancy BMI, particularly obesity, increases the risk of numerous adverse maternal and fetal outcomes including preeclampsia, gestational diabetes and fetal death.(2) The impact of obesity on physical health during pregnancy has been studied extensively, while the relationship between obesity and maternal mental health has been largely neglected. Mental disorders are among the most common complications of pregnancy. The 12-month prevalence of any psychiatric illness among US women who have been pregnant in the past year has been estimated at 25.3%, ranging from 0.4% for psychotic disorders to roughly 13% for mood disorders.(3)

In non-pregnant adults, obesity is associated with mental disorders including depression,(4) binge eating disorder,(5) and bipolar disorder.(6) In a recent meta-analysis of longitudinal studies, obese women had 67% higher odds of developing depression at follow-up than normal-weight women (unadjusted odds ratio 1.67; 95% confidence interval 1.11-2.51).(4) The extent to which the relationship exists during pregnancy and postpartum is not clear; research in this area is limited and findings have been inconsistent with no meta-analyses to date.(7-9) This study aimed to address the evidence gap by conducting a systematic review and meta-analysis to investigate the prevalence and risk of antenatal and postpartum mental disorders in women who were known to be overweight or obese at the start of pregnancy, compared with normal-weight controls.

Methods

The review followed MOOSE guidelines and the protocol was registered with the prospective register of systematic reviews (PROSPERO; registration number CRD42013003093).

Sources

Five bibliographic databases (MEDLINE, EMBASE, PsycINFO, CINAHL and MIDRIS Maternal) were searched from inception to January 7th 2013 using OvidSP. The Cochrane Library and [ClinicalTrials.gov](http://clinicaltrials.gov) were searched with the same date limits. Searches were conducted in English, using a combination of exploded Medical Subject Headings and text terms related to obesity, mental disorders, pregnancy and postpartum (see Appendix 1, available online at <http://links.lww.com/xxx>). We also conducted forward and backward citation tracking, hand-searched key journals (Obstetrics and Gynecology; BJOG: An International Journal of Obstetrics and Gynaecology; International Journal of Obesity, all from 1998 onwards) and obtained expert recommendations for additional relevant studies.

Study selection

Studies were eligible for inclusion if they assessed antenatal (at any point in pregnancy) or postpartum (within a year after delivery) mental disorders in women who were overweight or obese at the start of pregnancy. Studies were not eligible for the review if we were unable

to extract or obtain data for overweight or obese women separately from normal-weight women. Data from studies with overweight or obese women only were used in the prevalence estimates but not for the evaluation of risk, which required normal-weight controls. Both diagnostic and screening measures for mental disorders were accepted, as were data extracted from routine records. Measures of stress, state anxiety or combined mental disorders were not eligible, nor were disorder classifications based entirely on medication status. Categorization of 'pre-pregnancy' overweight or obesity (based on measured or self-reported BMI) was accepted from within a year pre-pregnancy or during the first trimester, to prevent confounding by gestational weight gain. Only published, peer-reviewed English language papers were eligible. Data were accepted from cohort, case-control, cross-sectional and intervention studies (baseline data only).

All identified citations were downloaded to EndNote© software and titles and abstracts screened for relevance by one reviewer (EM). The full text versions of potentially relevant articles were obtained and assessed for eligibility. A second reviewer (CT) independently assessed the eligibility of 100 randomly selected citations and eligibility decisions were compared. Authors were contacted to determine whether identified conference papers or abstracts had been published in peer reviewed journals and raw data was requested if published studies did not present information in the required format. Where duplicate publications were identified, the data based on the largest sample size was included. One reviewer (EM) extracted data on study characteristics and results using a piloted form. Two reviewers (EM and SA-W) independently assessed the quality of included studies (low, moderate or high) using a tool adapted from previous measures (see Appendix 2, available online at <http://links.lww.com/xxx>). (10,11) Discrepancies were resolved through discussion with the senior author (LH). Studies were assessed for risk of selection and measurement bias and those with high risk of bias in either area were defined as low quality and excluded from the meta-analysis. This included studies that used non-validated screening measures, studies which excluded women with a current or previous diagnosis of the mental disorder in question and case-control studies which selected participants on a characteristic likely to bias findings (e.g. preeclampsia, fetal mortality). Studies were defined as high quality if they had population-based samples and used either diagnostic measures of mental disorders or well-validated and widely used screening measures (such as the Edinburgh Postnatal Depression Scale).

Studies were grouped by mental disorder and time period (antenatal or postpartum). Heterogeneity between studies was explored using the I^2 statistic and pooled estimates were not calculated in cases of high heterogeneity ($I^2 > 90\%$). In all cases, heterogeneity was too large to pool prevalence data, therefore data from high quality studies were used to calculate median prevalence estimates (with interquartile range, IQR). Heterogeneity of odds ratios (OR) was low to moderate so pooled estimates with 95% confidence intervals (95% CI) were calculated for each disorder and time period using DerSimonian-Laird random-effects meta-analysis if sufficient studies were available. (12) Odds ratios for obese and overweight women were pooled separately, with normal-weight women as the reference group, and forest plots constructed. Studies which only provided combined data for overweight and obese women were excluded from the meta-analyses. Where significantly increased odds were found for both overweight and obese women separately, pooled estimates were

calculated for the odds of the disorder in obese women using overweight women as the reference group, to investigate whether there was a dose-response relationship.

We performed sensitivity analyses (for example, including only high quality studies, studies using diagnostic measures or studies providing adjusted odds ratios) and influence analyses (removing each study in turn from the pooled estimates). Unless otherwise stated, these did not substantially alter findings. Publication bias was assessed through visual inspection of funnel plots and Peter's test.⁽¹³⁾ All statistical analyses were conducted using Stata 12 (Stata Corp, Texas).

Results

A flow diagram of the study selection process is given in Figure 1. Overall 4,687 unique references were screened and the full texts of 571 potentially eligible studies were obtained. Of these, 509 were excluded (reasons for full text exclusions are given in Figure 1). In total 62 studies with 540,373 women were included in the review: 75,108 obese women, 126,990 overweight women and 337,533 normal-weight women (with 742 women in combined overweight and obese categories). The majority of studies were conducted in high-income countries with only nine from low- or middle-income countries (including a total of 614 obese women).⁽¹⁴⁻²²⁾ Five of these studies also focused on low income women within these countries (15-17,19,21). Of the studies in high-income countries, eight focused on low-income (23-27) or ethnic-minority women.⁽²⁸⁻³⁰⁾ Timing of mental disorder assessment ranged between 10 and 36 weeks gestation and 1 week to 1 year postpartum.

An overview of included studies is given in Table 1; several studies provided data for more than one mental disorder or time period. All individual study characteristics and results are given in the included studies table (see Appendix 3 online at <http://links.lww.com/xxx>). The systematic review identified 39 studies examining antenatal depression, (7-9,14-18,23,24,28-56) of which 29 were eligible for the meta-analysis. (7,8,14-16,24,28,29,33-53) The majority of these studies identified women with elevated depression symptoms using the Centre for Epidemiological Studies Depression Scale (n=15; 13 with a cut-off 16, one with a cut-off 17 and one used the short-form CESD with a cut-off of 11) or the Edinburgh Postnatal Depression Scale (n=5; four used the cut-off 13, one used a Chinese translation with a validated cut-off 10). The median prevalence of elevated depression symptoms was highest in obese women (33.0%) and lowest in normal-weight women (22.6%) based on the seven high-quality studies.^(16,48-53) Median prevalence and interquartile range estimates are given in Table 2. As shown in Table 3, obese women had significantly higher odds of antenatal depression than normal-weight controls (see Figure 2), as did overweight women. Obese women also had significantly elevated odds of depression when compared with overweight women as the reference group, providing evidence of a dose-response relationship. There was no evidence of publication bias for studies on antenatal depression or for any of the other meta-analyses conducted. In sensitivity analyses, pooled effect sizes increased when only high quality studies were included for both obese (OR 1.59, 95% CI 1.32-1.91) and overweight women (OR 1.41, 95% CI 1.28-1.54) compared with normal weight controls. Removing studies with obesity-related health exclusion criteria (e.g. history of diabetes) from the meta-analysis also increased effect sizes for obese women

(OR: 1.56, 95%CI 1.44-1.69). There were insufficient studies using diagnostic measures or presenting adjusted odds ratios to pool this data; however both studies using diagnostic measures of depression (16,57) found higher odds among obese women, and the single study providing adjusted odds ratios showed that the association between obesity and depression remained significant after adjusting for maternal ethnicity.(37)

The systematic review identified 23 studies that assessed postpartum depression (19,20,22,25-27,36,38,42,50,51,55,58-67) of which 16 were included in the meta-analysis. (20,22,26,27,36,38,42,50,51,58-63) Again, the majority of these studies used the Centre for Epidemiological Studies Depression Scale (n=5; all with a cut-off 16) or the Edinburgh Postnatal Depression Scale (n=6; four with a cut-off 13, one with a cut-off 10 and one Japanese translation with a validated cut-off 9). Based on five high quality studies, (22,50,51,63) the median prevalence of elevated postpartum depression symptoms ranged from 13.0% for obese women to 9.9% for normal-weight women (see Table 2).

As shown in Table 3, significantly higher odds of postpartum depression were found for both obese (see Figure 3) and overweight women compared with normal-weight controls. Obese women also had significantly increased odds of postpartum depression when compared with overweight controls, again giving evidence of a dose-response relationship. Heterogeneity and confidence intervals for overweight women increased in size when only the five high-quality studies were included in sensitivity analyses (OR: 1.08, 95%CI: 0.97-1.21). No studies used diagnostic measures for postpartum depression. One study eligible for the meta-analysis presented adjusted data and found no significant association between obesity and depression after extensive adjustment for confounding (including age, ethnicity, education, maternal morbidities, smoking and alcohol use, birth-weight and breastfeeding practice).(62) The review identified 16 studies that assessed antenatal anxiety, (9,16,18,21,31,32,38,39,42,47,48,52,54,68-70) including 10 that were eligible for the meta-analysis.(16,38,39,42,47,48,52,68-70) The majority of these studies (n=7) used the trait subscale or complete scale of the State-Trait Anxiety Inventory (cut-offs between 40 and 45; one paper used the 10-item version of the trait subscale with the cut-off >20 (75th percentile)). In the one high quality study identified, conducted with low-income women in Brazil, the prevalence of anxiety disorders was 35.0% in obese women, 35.7% in overweight women and 31.0% in normal-weight women.(16) There were significantly higher odds of elevated anxiety among obese than normal-weight women (see Figure 4) but the effect was not significant comparing overweight and normal-weight women (data shown in Table 3). In sensitivity analyses, the odds ratio for overweight women increased following the exclusion of studies with obesity-related health exclusion criteria (OR: 1.13, 95%CI 1.00-1.27). One study used a diagnostic measure of anxiety and found that obese and overweight women both had higher odds of antenatal anxiety than normal-weight women, although neither effect was significant.(16) No studies presented adjusted odds ratios.

Three studies examining postpartum anxiety were identified.(38,42,47) Median prevalence estimates were not calculated as there were no high quality studies. In the individual studies, elevated anxiety symptom prevalence estimates for obese women varied from 4.7% (4.0% for overweight women and 4.2% for normal-weight women; using UK primary care records) (42) to 33.3% (13.3% for overweight women and 16.4% in normal-weight women; based on

the State-Trait Anxiety Inventory).(38) There were insufficient data to perform a meta-analysis however individual study findings showed higher odds of postpartum anxiety in obese women than normal-weight controls (although this was only significant in one study). There was no evidence of elevated odds for overweight women.

Antenatal binge eating disorder was examined in two European studies using screening measures.(71,72) Both studies found the highest prevalence among obese women (3.8%;(71) 6.5%)(72) and the lowest in normal-weight women (1.0%;(71) 4.2%),(72) although the increased risk for obese women was significant in one study only.(72) Both studies also estimated the prevalence of antenatal bulimia nervosa; one found no cases among normal weight, overweight or obese women,(71) and the other found a prevalence of 0.29% in obese women, 0.17% in overweight women and 0.26% in normal-weight women.(72) No studies examining postpartum eating disorders were identified.

Two studies were identified examining serious mental illness.(42,73) One high quality study that used linked Swedish health registers estimated the lifetime prevalence of bipolar disorder among pregnant women as 0.42% for obese women, 0.30% for overweight women and 0.21% for normal-weight women, with the odds of bipolar disorder significantly higher for both obese and overweight women compared with normal weight controls.(73) The other study,(42) which used UK primary care records, estimated the period prevalence of serious mental illness (bipolar disorder, schizophrenia or other psychotic disorders) during pregnancy as 0.21%, 0.09% and 0.13% for obese, overweight and normal-weight women respectively. The estimated prevalence in the first 9 months postpartum was 0.23% for both obese and overweight woman and 0.19% among normal-weight women. No effects were significant.

Conclusion

This systematic review and meta-analysis found that women who are obese when they become pregnant have significantly higher odds of elevated depression symptoms than normal-weight women in both the antenatal and postpartum periods (43% and 30% increased odds respectively), with intermediate risks for overweight women. Obese women also had higher odds of elevated anxiety during pregnancy than normal-weight women. There was some evidence of an increased risk of other mental disorders among obese women including postpartum anxiety, binge eating disorder and bipolar disorder; however there were insufficient studies to draw conclusions about these diagnoses.

This review provides a comprehensive summary of previous literature on the association between pre-pregnancy obesity and mental disorders during pregnancy and postpartum. Extensive contact with study authors to obtain raw data enabled the inclusion of studies that had not previously used their data to assess the relationship between pre-pregnancy obesity and mental disorders. Low quality studies were excluded from the meta-analysis and findings were robust to sensitivity and influence analyses, increasing our confidence in the conclusions. Dose-response relationships were found between BMI category and both antenatal and postpartum depression, which also supports the hypothesized relationship between increased BMI and risk of depression.

The review had a number of limitations, including the widespread use of self-reported height and weight in the included studies which may lead to BMI misclassification. However, studies have shown that the vast majority of women are assigned to the correct pre-pregnancy BMI category based on self-reported weight,(74) and that symptoms of depression or binge eating disorder do not affect the accuracy of self-reported BMI.(75) Very few studies used diagnostic measures of mental disorders so our findings refer to individuals with elevated symptoms not diagnostic cases; nevertheless the conclusions are important as elevated but sub-clinical symptoms are associated with adverse outcomes during pregnancy and postpartum. Only studies using validated scales were included in the meta-analyses but further validations for specific populations (such as women in early pregnancy) are needed. Studies used a number of different screening measures and cut-offs which will have contributed to the heterogeneity in prevalence estimates, however this allowed a large number of studies to be included which is a strength of this review. Only published studies were eligible which ensures the quality associated with peer-review but can lead to bias; however, funnel plots for the included studies showed no evidence of publication bias. Finally, few studies were carried out in low- and middle income countries which reduces generalizability, as does the inclusion of only English language papers due to limited resources.

Our results are in-keeping with a substantial body of research showing increased risk of mental disorders among non-pregnant obese women.(4-6) Some researchers have suggested that high BMI and depression may not be associated during pregnancy because excess weight is viewed less negatively at this time,(7) but this hypothesis is not supported by our findings. Weight stigmatization can be present throughout the childbearing period and other factors such as physical ill health and poor diet may contribute to the effect of obesity on mental disorders.(4) Pregnancy-related factors (such as gestational diabetes or backache) could also play a role in the association. In addition, the reverse causal pathway may be important as women with a history of depression could have gained weight prior to pregnancy. A number of factors have been suggested to explain the increased risk of weight gain among women with mental disorders, for example the obesogenic effects of several antipsychotics and antidepressant medications.(76) Confounding factors such as low socioeconomic status, which are associated with both pre-pregnancy obesity and mental illness, may also account at least in part for the associations observed. A limitation of our review is that only non-adjusted pooled summary statistics could be calculated as very few studies presented adjusted estimates. One included study found no association between obesity and postpartum depression after extensive adjustment for confounders, but further investigation of this is needed.

Although our review cannot provide causal inferences, the identification of the increased prevalence and risk of antenatal and postpartum mental disorders among obese (and overweight) women has important implications for clinical care and future research. Both obesity and mental illness during pregnancy are associated with adverse pregnancy outcomes, and their co-morbid impact may lead to a particularly high risk group. Recent research has found that women with antenatal depression have higher risks of gestational diabetes and preeclampsia than women without depression,(17,77) but these findings need to be replicated in subgroups of obese women. In addition, behavioral change interventions for

obese pregnant or postpartum women (e.g. improving diet, increasing physical activity) may need to be tailored for women with poor mental health.(78) Based on our findings in this review, around one third of obese pregnant women have elevated symptoms of depression and the impact of this on health behaviors and behavior change needs to be evaluated in future research.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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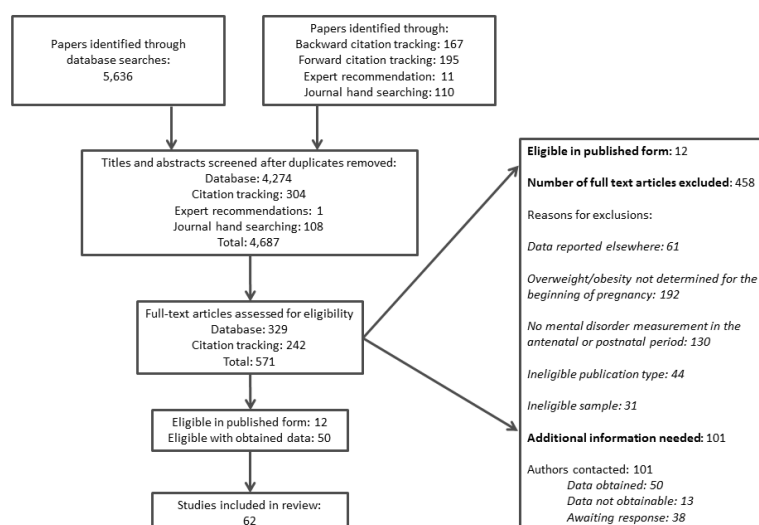
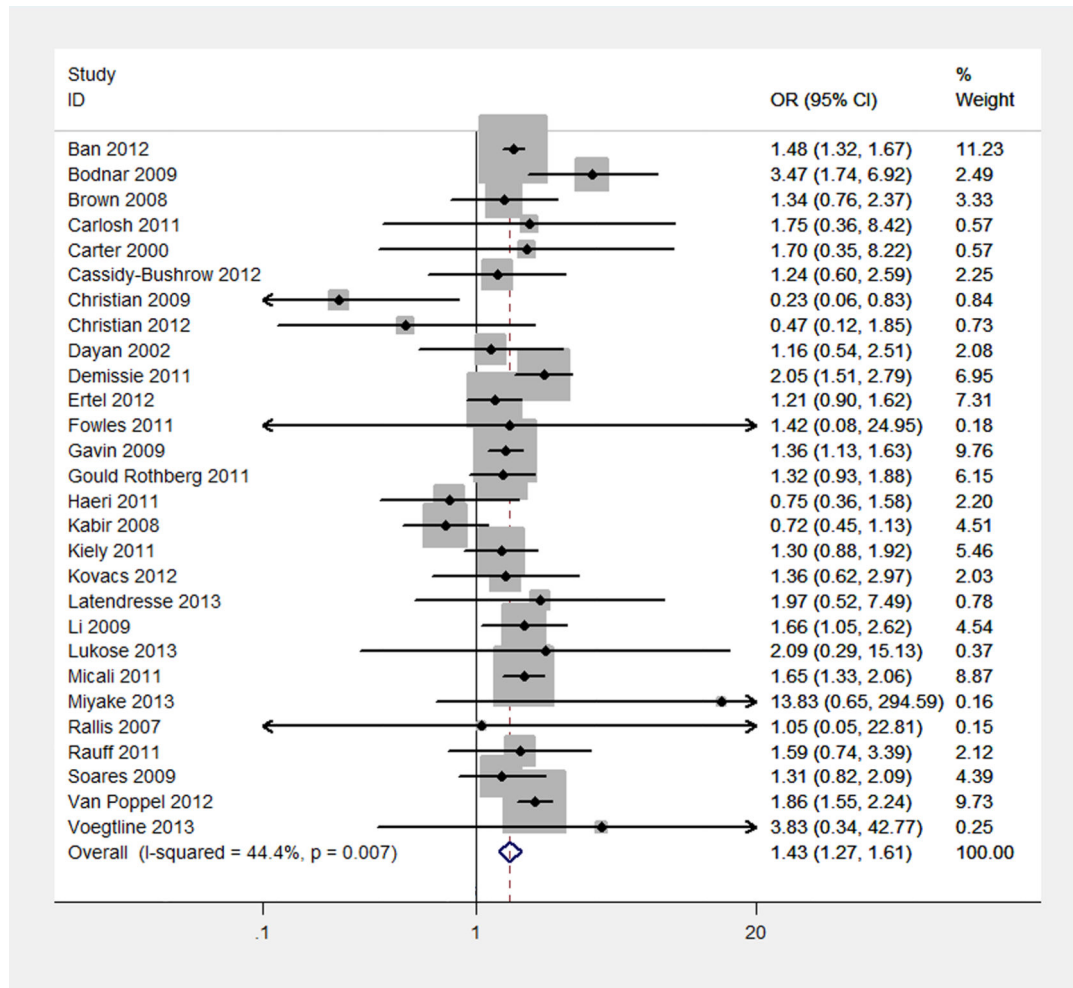


Figure 1.
Study selection flow diagram.

**Figure 2.**

Pooled odds of antenatal depression in obese women compared with normal weight controls.

OR: odds ratio, CI: confidence interval.

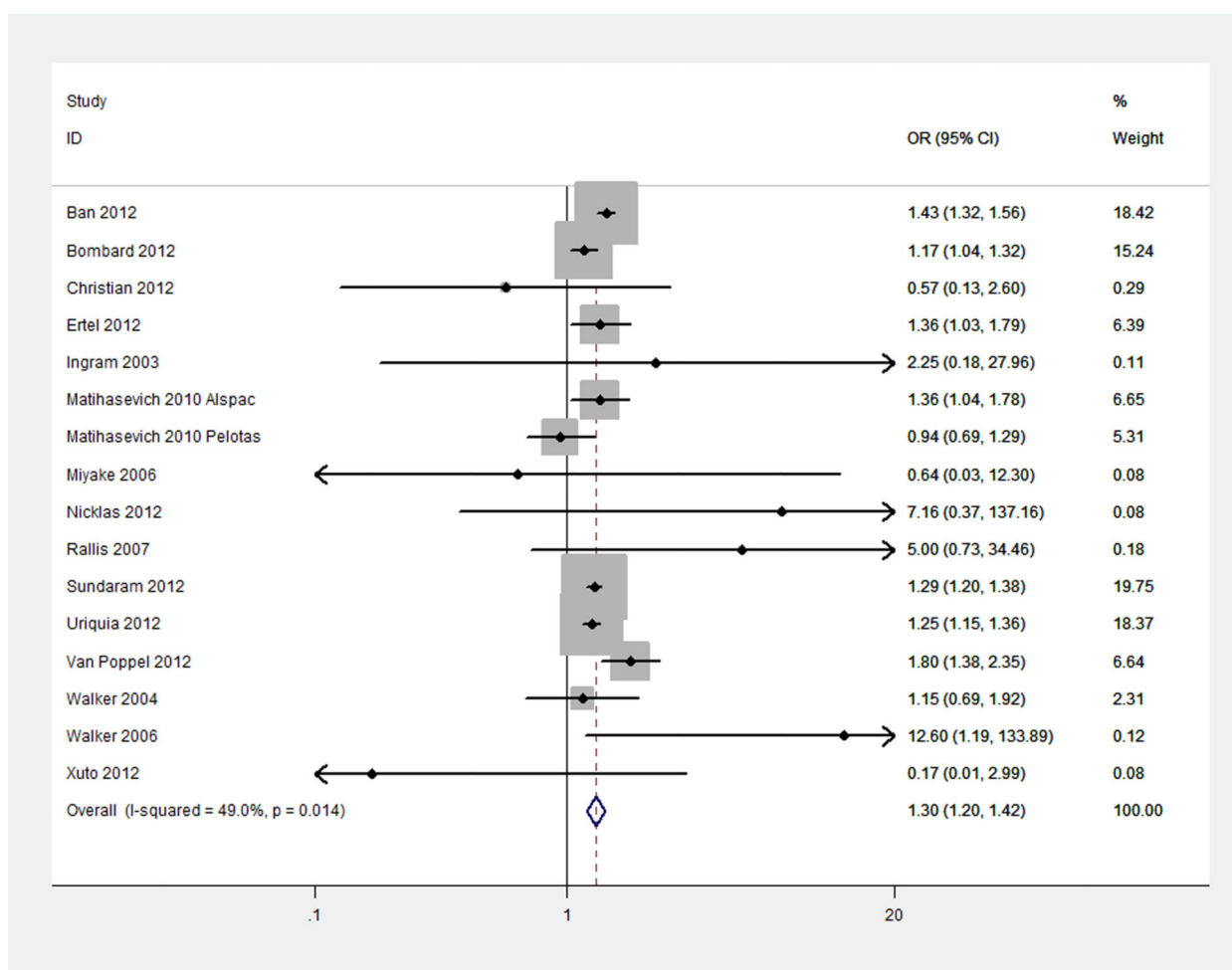


Figure 3. Pooled odds of postpartum depression in obese women compared with normal weight controls. OR: odds ratio, CI: confidence interval.

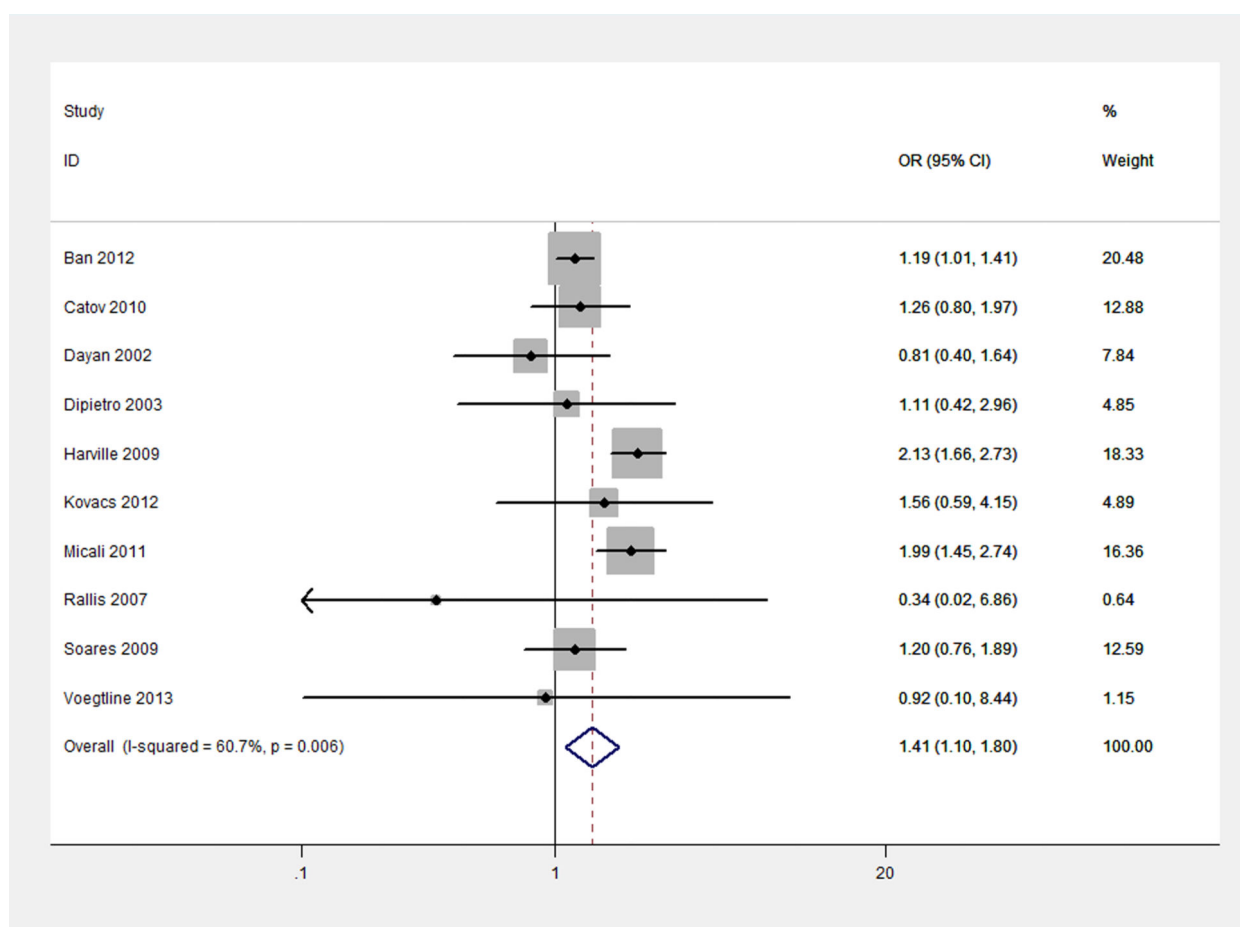


Figure 4.
Pooled odds of antenatal anxiety in obese women compared with normal weight controls.
OR: odds ratio, CI: confidence interval.

Table 1
Summary of Included Study Characteristics

	All included studies	Antenatal depression	Postpartum depression	Antenatal anxiety	Postpartum anxiety	Antenatal eating disorders	Antenatal serious mental illness	Postpartum serious mental illness
Total number of studies *	62	39	23	16	3	2	2	1
Region								
North America	35	22	11	6	-	-	-	-
Europe	14	9	7	6	2	2	2	1
Australasia	2	2	1	1	1	-	-	-
South America	6	3	2	3	-	-	-	-
Asia	5	3	2	-	-	-	-	-
Study design								
Prospective cohort study	38	24	16	9	2	1	-	-
Retrospective cohort study	3	1	2	1	1	-	2	1
Cross sectional study	12	5	5	2	-	1	-	-
Case control study	4	4	-	2	-	-	-	-
Trial (baseline)	5	5	-	2	-	-	-	-
Sample size								
<50	5	4	2	2	-	-	-	-
50-500	28	18	10	5	1	1	-	-
>500	29	17	11	9	2	1	2	1
BMI								
Measured in first trimester	5	3	2	1	-	-	-	-
Extracted from records	9	7	2	4	1	-	2	1
Pre-pregnancy weight reported in pregnancy	37	28	9	11	2	2	-	-
Pre-pregnancy weight reported postpartum	11	1	10	-	-	-	-	-
BMI categories								
Institute of Medicine (2009) †	50	32	20	11	3	2	2	1
Institute of Medicine (1990) ‡	8	4	3	3	-	-	-	-
Other	4	3	-	2	-	-	-	-
Mental disorder assessment								
Diagnostic measure	2	2	-	1	-	-	-	-
Extracted from records	4	3	1	2	1	-	2	1
Screening measure	56	34	22	13	2	2	-	-

* Many studies included data for more than one disorder or time period

† Institute of Medicine 2009 categories: normal weight 18.5-25kg/m²; overweight 25-30kg/m²; obese >30kg/m²

‡ Institute of Medicine 1990 categories: normal weight 19.8-26kg/m²; overweight 26-29kg/m²; obese >29kg/m²

Table 2
Median Prevalence and Interquartile Range for Antenatal and Postpartum Depression

	Median Prevalence (%)	Interquartile Range (%)
Antenatal depression		
Obese	33.0	11.2-42.0
Overweight	28.6	12.4-36.6
Normal weight	22.6	9.5-27.9
Postpartum depression		
Obese	13.0	12.2-14.1
Overweight	11.8	9.6-13.5
Normal weight	9.9	9.3-14.0

Table 3
Unadjusted pooled odds ratios

	Reference Group	Pooled Odds Ratio	95% Confidence Intervals	P	Heterogeneity I ² (%)
Antenatal depression					
Obese	Normal weight	1.43	1.27-1.61	<0.001	44.4
Overweight	Normal weight	1.19	1.09-1.31	<0.001	32.1
Obese	Overweight	1.21	1.06-1.37	<0.001	33.6
Postpartum depression					
Obese	Normal weight	1.30	1.20-1.42	<0.001	49.0
Overweight	Normal weight	1.09	1.05-1.13	<0.001	0.0
Obese	Overweight	1.20	1.13-1.27	<0.001	9.7
Antenatal anxiety					
Obese	Normal weight	1.41	1.10-1.80	0.006	60.7
Overweight	Normal weight	1.10	0.98-1.23	0.094	0.0